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Note on the Scaling of Dr. Spitta's Wedge by means of Photography.

By Captain W. de W. Abney, C.B., D.C.L., F.R.S.

Two or three meetings ago Dr. Spitta read a paper on the scaling of his wedge as used for astronomical purposes, and in the discussion which followed I said that wedges could also be scaled photographically. The scaling, I need scarcely say, referred to the determination of the absorption coefficient per unit of length. Dr. Spitta kindly placed his wedge at my disposal, and I must premise that until I had more than half completed my experiments I had no idea what the coefficient he had determined was, nor the unit of length for which he took it. On subsequently reading his paper in the *Monthly Notices*, I was still at a loss to know these points, as he had not expressly stated the latter, and had to ask him by letter what they were. The wedge he lent me is one cut out of what I suppose ought to be neutral tint, but which is really a species of bottle-green glass. Examining it in the spectrum it was easy to see that there was a much larger absorption coefficient in the red than in the green, and in the green than in the blue-green. Beyond that, it was unnecessary to examine the wedge in this manner. My first experiment was to determine its absorption for the rays which act on iron salts, the maximum of which lies in the blue-green rays. For this purpose I employed the ordinary platinum paper supplied by the Platinotype Company. A strip was placed in contact with the wedge and exposed to the direct light from an arc electric light, care being taken to prevent any light penetrating through the sides of it. The light was placed at such a distance from the wedge that practically the rays falling on it were parallel rays. Simultaneously, and with the proper precautions, a piece of platinum paper was exposed in a Spurge sensitometer, which I have described in a paper read before the Society last year. The papers were developed together and washed and dried, the paper having been previously marked off in $\frac{1}{4}$ inches, that all error due to shrinkage might be avoided. The sensitometer print was measured for blackness, and a curve constructed; the abscissæ used were the known intensities of light, and the ordinates the blackness, or perhaps I should say the amount of whiteness left. This was measured with my photometer in the way I have described here and in other papers. The wedge print was measured in the same way at every $\frac{1}{4}$ of an inch, and the intensities of light acting at every $\frac{1}{4}$ inch derived from the curve, the amount of whiteness indicating the intensity which had acted.

The measurements gave me the coefficient of absorption. This gave a star magnitude of 1·38 per inch.

Now evidently the value thus obtained would not be the same as the value to the eye, since it is the yellow part of the spectrum which has most effect on the latter and the

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blue on the former. To obtain this value a solution of chromate of potash was placed in front of the light, and a Carbutt film of bromide of silver placed in contact with the wedge, a sensitometer containing the same sensitive surface being exposed simultaneously to the same light. This light gave the maximum photographic sensitiveness in the yellow-green, and accorded very well with that of the eye. The densities of the sensitometer negative and of the wedge negative were measured as before, and in this case the star magnitude per inch came out 1·20 to 1·21. Another experiment gave the value of 1·21 to 1·22, whilst a third gave the value 1 20 to 1 22. We may take it that the value does not much differ from 1·21. To determine the coefficient in red light, the wedge and sensitometer were exposed to light passing through what is known as stained red glass. It is a glass preferable to ruby glass, as this last allows a small percentage of blue rays to pass. Proceeding as before in measuring the negatives, in two experiments the values ·96 and ·93, or a mean of ·945, were obtained. It was only after the second set of experiments with the light passing through the chromate cell that I communicated with Dr. Spitta. He then informed me that his coefficients per inch gave him the following figures in star magnitudes :—

By method of reflection from mirrors	1·192
By rotating photometer	1·176
By polarising method with diaphragm	1·160
By " " without diaphragm	1·42

The only result of mine comparable with these is that obtained with light passing through the chromate solution, which gave me 1·21, a value a little higher than his value, 1·192.

I think this small discrepancy can be accounted for, if we take into consideration that he used gaslight—a light which contains a greater proportion of red and yellow than does sunlight; for, as has been stated, the red light is more absorbed than the yellow by this particular wedge. This being so, the maximum optical effect would be obtained in a part of the spectrum slightly nearer to the red than he would have obtained with sunlight.

The light I used was the electric light; and I have shown that the light from the positive pole of the electric light is very nearly the same as that of sunlight at noon about the middle of May. The results obtained with the electric light would therefore be very closely the same as that obtained with sunlight or with certain classes of stars.

The experiments I have carried out seem to point to this wedge having a different coefficient for different classes of stars. The difference should be most observable in red stars.

In conclusion, I may say that as well as films I tried glass

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plates backed with a black material to avoid halation. I was not satisfied that halation would not throw out the accuracy of results somewhat. The experiments showed that my fears were groundless.

I think it satisfactory, at all events, for the photographic method of scaling, that Dr. Spitta's and my own coefficients come out so close as they do. The wedge seems to be very uniform in its coefficient of absorption throughout, as the results at the darker end were the same as those of the lighter.

Note on some Variable Stars near the Cluster 5 *M.*

By A. A. Common, F.R.S.

On comparing some photographs of the Cluster 5 Messier lately taken with the five-foot telescope, I was surprised to find that on one plate there were stars that were quite invisible on the other plates. Considerable variation in the size of the impressions of the stars on the plate is not at all unusual, but the appearance of new stars of considerable magnitude on one plate, without a trace of them on plates taken before and after, is worthy of notice. Four photographs of this Cluster have been taken this year—on April 22, May 9, May 15, and June 9, with 25, 45, 66, and 45 minutes' exposure respectively.

The plate taken on May 15, with the longest exposure, contains five stars not shown on the other plates; the position with regard to the centre of the Cluster is given below :—

No.	Mag.	Æ	δ
1	9·5	20 *p*	19′ N
2	10·0	10 *f*	1·5 N
3	9·5	40 *f*	12 S
4	10·0	56 *f*	20 S
5	9·0	66 *f*	10·5 N

The magnitude of the above stars is estimated from the 9·5 (Argelander) star about 18′ south of the Cluster.

The plate on which these stars appear has more stars than the other three plates, owing to the longer exposure, but stars of at least the 12th magnitude are shown on all of them; so that the presence of the new stars is not due to the longer exposure. On re-measuring the plates, to check the position of the five stars, I find that there is a great difference in the apparent magnitude of many of the stars near the Cluster, particularly with one star of about 10· magnitude, about 3^s *f* the centre of Cluster: on the 1st, 3rd, and 4th plates it is an unmistakable object; on the 2nd plate, taken May 9, it is there, but just the same magnitude as the other stars of the Cluster—possibly two magnitudes less than its magnitude on the other plates.